A METHOD, APPARATUS AND/OR COMPUTER PROGRAM FOR CONTROLLING LIGHT OUTPUT OF A DISPLAY

TECHNOLOGICAL FIELD

[0001] Embodiments of the present invention relate to a method, an apparatus and/or a computer program for controlling light output from a display.

BACKGROUND

[0002] Ambient light has an effect on how an image displayed in a display device appears to a user. As the ambient light changes, the appearance of the image changes. For example, the contrast and/or colour saturation may be affected by ambient light.

[0003] In some situations ambient light can change very rapidly, for example, when entering into bright sunshine.

[0004] Existing methodologies for adapting the output of a display device in response to changing ambient lighting conditions have a number of drawbacks. It would therefore be desirable to provide a different method for controlling light output of a display.

BRIEF SUMMARY

[0005] According to various, but not necessarily all, embodiments of the invention there is provided a method comprising: causing synchronisation of a local time frame and refresh of a display; processing an output from a light sensor from a first time, in the local time frame, for a controlled first duration to control light output of the display at a second time, in the local time frame and after the first time, for a second duration.

[0006] According to various, but not necessarily all, embodiments of the invention there is provided a method comprising: switching a light source for a display off during a first duration of a display period; measuring ambient light during each first duration of a display period; switching the light source for the display on during a second duration of a display period with an adjusted light output, dependent on the measurement of ambient light made in the first duration of the display period.

[0007] According to various, but not necessarily all, embodiments of the invention there is provided an apparatus comprising: an ambient light sensor configured to sense ambient light; a light source configured to emit light; and optics shared by the light sensor and the light source, wherein the optics is configured to provide equivalent light paths, in opposite directions, for ambient light sensed at the light sensor and for emitted light emitted from the light source

[0008] According to various, but not necessarily all, embodiments of the invention there is provided examples as claimed in the appended claims.

BRIEF DESCRIPTION

[0009] For a better understanding of various examples that are useful for understanding the brief description, reference will now be made by way of example only to the accompanying drawings in which:

[0010] FIG. **1** illustrates an example of an apparatus comprising a light sensor, a controller and a light source;

[0011] FIG. **2** illustrates an example of a method which may, for example, be performed by the apparatus;

[0012] FIG. **3** illustrates an example of timing of a sensing event and a light output event in relation to a common local time frame;

[0013] FIG. **4** illustrates an example of a method for controlling light output of the display;

[0014] FIG. **5** illustrates an example of an apparatus similar to the apparatus illustrated in FIG. **1** and additionally comprising a display;

[0015] FIG. **6** schematically illustrates an apparatus configured such that an angular/spatial distribution of sensed ambient light is the same as an angular distribution of the emitted light;

[0016] FIG. **7**A illustrates an example light ray for sensed ambient light;

[0017] FIG. **7**B illustrates an example light ray for emitted light;

[0018] FIG. **8**A illustrates an example of a controller; and

[0019] FIG. **8**B illustrates an example of a record carrier for a computer program.

DETAILED DESCRIPTION

[0020] The inventor has developed various innovative approaches to improving control of light output from a display in response to sensed light.

[0021] For example, by synchronizing light sensing and display output to a common time frame, it is possible to provide a fast response to changing ambient lighting conditions that avoids flicker in the display.

[0022] For example, it is possible to provide for more accurate response to ambient lighting conditions by arranging for the use of equivalent light paths, in opposite directions, for sensing ambient light and for outputting light. In this way, provided that the optical stack response is symmetrical with respect to the display stack normal, the field of view (FoV) of the light source and of the light sensor are the same. This means that the angular/spatial distribution of sensed ambient light is the same as the angular/spatial distribution of emitted light. Also the spectral modulation of sensed ambient light may be same as a spectral modulation of light emitted. In this way, if the output of the light source is matched to the sensed light, then the output of the display is accurately matched to the ambient lighting conditions both with respect to luminance and colour temperature.

[0023] In some, but not necessarily all, examples the light sensor may be directly connected to circuitry that controls the light output. This reduces latencies and provides for faster operation.

[0024] FIG. **1** illustrates and example of an apparatus **2** comprising a light sensor **10**, a controller **30** and a light source **20**.

[0025] The light sensor **10** is directly connected to the controller **30**. An output **12** from the light sensor **10** is therefore received by the controller **30** with little, if any, delay.

[0026] The light sensor **10** may be any suitable light sensor. The light sensor **10** may sense one or more spectral channels. The light sensor **10** may, for example, be an avalanche photodiode, a solid-state photo-multiplier tube, a PN-junction photodiode, or a phototransistor.

[0027] In some, but not necessarily all examples, the light sensor **10** may be an ambient light sensor or an internal light sensor, or both. The purpose of an ambient light sensor is to